ENERGY ENGINEERING ANALYSIS PROGRAM

FORT JACKSON, SOUTH CAROLINA

ENERGY AUDIT FOR MONCRIEF ARMY COMMUNITY HOSPITAL, OLIVER DENTAL CLINIC, CALDWELL DENTAL CLINIC, AND HAGEN DENTAL CLINIC

FINAL REPORT

SEPTEMBER, 1987

VOLUME I – EXECUTIVE SUMMARY

Prepared for

SAVANNAH DISTRICT, CORPS OF ENGINEERS

P.O. BOX 889

SAVANNAH, GEORGIA 31402-0889

By

BENATECH, INC.

Engineering and Energy Consultants

1215 HIGHTOWER TRAIL, SUITE D-220

ATLANTA, GEORGIA 30350

ARMY CONTRACT NO. DACA21-86-C-0503

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
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1. EXECUTIVE SUMMARY

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1.1 INTRODUCTION

This is the Executive Summary of an Energy Engineering Analysis Program (EEAP) Study that was conducted at Moncrief Army Community Hospital, Fort Jackson, South Carolina, by the firm of BENATECH, INC. The Scope of Work (copy included in Appendix A, Volume II, also includes studies of three other facilities; Oliver Dental Clinic, Caldwell Dental Clinic, and Hagen Dental Clinic.

This EEAP study identifies cost-effective Energy Conservation Opportunities (ECO's) and prepares appropriate programming documentation for these ECO's.

The following activities have been accomplished:

- A detailed field investigation has been conducted.
- ECO calculations have been performed and ECIP analyses completed.
- Interim Report has been submitted.
- Project documentation packages have been compiled.
- Executive Summary has been incorporated into the report.

1.2 BUILDING DATA

Moncrief Army Community Hospital, Building 4500, provides inpatient hospital care and several outpatient clinics. The beneficial occupancy date of the hospital was April, 1972. The 12 story structure has 321,821 square feet.

Oliver Dental Clinic (Building 4323), Caldwell Dental Clinic (Building 4590), and Hagen Dental Clinic (Building 5330), all provide dental care services. The facilities are all single story structures. Their square footage and beneficial occupancy dates are listed below:

CLINIC	SQUARE FOOTAGE	BENEFICIAL OCCUPANCY DATE
Oliver	11,897	November, 1969
Caldwell	12,665	November, 1969
Hagen	11,897	May, 1980

1.3 PRESENT ENERGY CONSUMPTION

There is no utility metering at the hospital, therefore, there are no past utility consumption records. PC-DOE Computer Simulation was used to estimate annual energy consumption by the hospital.

The present total annual source energy consumption by the hospital is 96,168 million BTU's (MBTU) per year at a total cost of $524,614 per year. This corresponds to an Energy Utilization Index (EUI) of 298,825 BTU per square foot per year. A typical EUI for a hospital in a similar climate is 262,000 BTU per square foot per year*.

A breakdown of present annual energy consumption by source and system is shown in Table 1-T1.

A summary of present annual source energy consumption and costs follow:

FUEL SOURCE	ANNUAL QUANTITY	ANNUAL DOLLARS**	ANNUAL MBTU
Electricity	6,354,500 Kwh	$160,056	21,688
#6 Fuel Oil	93,293 Gallons	$ 59,754	13,994
#2 Fuel Oil	1,947 Gallons	$ 1,661	270
Natural Gas	602,140 Therms	$303,379	60,214

Figure 1-F1 graphically depicts present energy consumption by system. A summary follows:

SYSTEM	ANNUAL MBTU	ANNUAL DOLLARS**
Domestic Hot Water	1,371	$ 6,708
Kitchen Equipment	2,036	$ 13,095
Lighting	4,876	$ 35,984
Miscellaneous Equipment	7,133	$ 50,279
Emergency Generators	270	$ 1,661
HVAC	80,482	$416,887

* Source: Energy Information Administration, 1979, Non-Residential Buildings Energy Consumption Survey, Published 1983.

** A difference of 0.04% between the totals of these two columns is due to rounding error.

1.4 ENERGY CONSERVATION ANALYSIS

A total of 63 Energy Conservation Opportunities (ECO's) were considered. A list of ECO's considered is shown in Table 1-T7. Of these, 21 had already been implemented or else were not applicable to the facilities studied. The remaining 42 ECO's were evaluated.

Savings-to-Investment Ratios (SIR's) were calculated for each ECO evaluated. Those ECO's with SIR's greater than or equal to one were recommended. ECO's with SIR's less than one were rejected. Summaries of recommended ECO's are shown in Tables 1-T3, 1-T4, 1-T5, and 1-T6.

With guidance from the DEH at Fort Jackson, selected ECO's were compiled into projects.

A total of three projects were developed. They are summarized below:

PROJECT NO.	DESCRIPTION	CONSTRUCTION COST	ANNUAL ENERGY SAVINGS	ANNUAL DOLLAR SAVINGS	SIR	SIMPLE PAYBACK YEARS
Project #1						
PECIP	HVAC & Bldg. Envelope ECO's	$158,725	5,468 MBTU Elect. 5,927 MBTU #6 25,249 MBTU Nat. Gas	$189,981	15.48	0.88
Project #2	Lighting					
PECIP	ECO's	$ 58,648	853 MBTU Elect.	15,054	2.94	3.89
Project #3	Hospital	$351,988	4,150 MBTU Elect. 3,381 MBTU #6 14,406 MBTU Nat. Gas.	$126,927	4.46	2.80
ECIP	EMCS					

Project #3, the hospital EMCS, is an alternative approach to several ECO's in Project #2. The implementation methods used in Project #2 are relatively low cost modifications to the existing hospital HVAC control systems. However, the reliability of the EMCS outlined in Project #3 is expected to be much higher than the controls retrofits described in Project #2, primarily due to monitoring capability and reduced maintenance.

It will be up to the installation to decide which method to use.

1.5 ENERGY AND COST SAVINGS

The total annual energy consumption by the hospital after implementation of all recommended ECO's is 57,041 MBTU per year at an annual cost of $317,906. The corresponding Energy Utilization Index (EUI) is 177,244 BTU per square foot per year. This value includes synergistic effects between ECO's. A table showing annual energy consumption at the hospital (including synergistic effects) after implementation of recommended ECO's is shown in Table 1-T2. Table 1-T3 lists potential savings for individual ECO's without synergistic effects.

The percentage of energy conserved at the hospital after implementation of all recommended ECO's is 41%. The hospital energy use and cost before and after all recommended ECO's are implemented follow:

	TOTAL ANNUAL MBTU'S	TOTAL ANNUAL COSTS
BEFORE	96,168	$524,614
AFTER	57,096	$318,312
SAVINGS	39,072	$206,302

These Before and After energy usages and costs are shown in Figures 1-F2 and 1-F3.

The annual energy savings and costs for the dental clinics are shown graphically in Figures 1-F4 and 1-F5. In summary, they are:

BUILDING	CLINIC	ANNUAL MBTU SAVINGS	ANNUAL COST SAVINGS
4323	Oliver	1,177	$6,816
4590	Caldwell	632	$7,892
5330	Hagen	540	$3,884

"SITE" and "SOURCE" Energy Evaluation:

The hospital and dental clinics are heated and cooled using High Temperature Water and Chilled Water generated by Central Energy Plant No. 2. "SITE" High Temperature Water (HTW) savings result in "SOURCE" savings of natural gas and #6 fuel oil at Central Energy Plant No. 2. "SITE" Chilled Water (CHW) savings result in "SOURCE" absorption chilling savings, electric centrifugal chiller savings, or a combination of both. Absorption chilling savings result in savings of natural gas, #6 fuel oil, and electricity.

1.6 ENERGY PLAN

Following is a summary of projects, including total cost, SIR, and implementation dates.

PROJECT NO.	TOTAL COST	SIMPLE PAYBACK	IMPLEMENTATION DATE	
Project #1 (PECIP)	$158,725	0.84	15.48	1990
Project #2 (PECIP)	$ 58,648	3.89	2.94	1990
Project #3 (ECIP)	$351,988	2.8	4.46	1990

MONCRIEF ARMY COMMUNITY HOSPITAL
ANNUAL ENERGY CONSUMPTION
EXISTING CONDITIONS (1986)

ENERGY CONSUMER	#6 FUEL OIL (SOURCE MBTU)	#6 FUEL OIL ($)	NATURAL GAS (SOURCE MBTU)	NATURAL GAS ($)	ELECTRICITY (SOURCE MBTU)	ELECTRICITY ($)	#2 FUEL OIL (SOURCE MBTU)	#2 FUEL OIL ($)	TOTAL ($)	TOTAL (SOURCE MBTU)
DOMESTIC HOT WATER	261	$1,114	1,110	$5,594	-	-	-	-	$6,708	1,371
KITCHEN EQUIP.	41	$176	771	$3,886	1,224	$9,033	-	-	$13,095	2,036
LIGHTING	-	-	-	-	4,876	$35,984	-	-	$35,984	4,876
MISC. EQUIP/MOTORS	-	-	-	-	6,223	$45,926	-	-	$45,926	6,223
STERILIZERS	5	$21	22	$11	-	-	-	-	$32	27
HVAC	13,157	$56,180	56,054	$282,512	9,365	$69,113	-	-	$407,569	78,578
FAILED STEAMTRAPS	168	$717	715	$3,604	-	-	-	-	$4,321	883
DEFECT. HUMIDIFIER	362	$1,546	1,542	$7,772	-	-	-	-	$9,318	1,904
EMERGENCY GENERATORS	-	-	-	-	-	-	270	$1,661	$1,661	270
TOTALS	13,994	$59,754	60,214	$303,379	21,688	$160,056	270	$1,661	$524,614	96,168

Total MBTU/YR = 96,168 MBTU/YR

ENERGY UTLIIZATION INDEX (EUI) = BTU/Gross SF-YR = 96,168,000,000 BTU/YR / 321,821 SF

= 298,825 BTU/SF-YR

TABLE 1 - T1

MONCRIEF ARMY COMMUNITY HOSPITAL
ANNUAL ENERGY CONSUMPTION
AFTER IMPLEMENTATION OF RECOMMENDED ECO's

ENERGY CONSUMER	#6 FUEL OIL		NATURAL GAS		ELECTRICITY		#2 FUEL OIL		TOTAL	TOTAL
	(SOURCE MBTU)	($)	(SOURCE MBTU)	($)	(SOURCE MBTU)	($)	(SOURCE MBTU)	($)	($)	(SOURCE MBTU)
DOMESTIC HOT WATER	220	$839	936	$4,717	-	-	-	-	$5,656	1,156
KITCHEN EQUIP.	41	$176	771	$3,886	1,224	$9,033	-	-	$13,095	2,036
LIGHTING	-	-	-	-	4,072	$30,051	-	-	$30,051	4,072
MISC. EQUIP/MOTORS	-	-	-	-	5,948	$43,896	-	-	$43,896	5,948
STERILIZERS	5	$21	22	$11	-	-	-	-	$32	27
HVAC	7,483	$31,867	31,795	$160,247	4,329	$31,948	-	-	$223,921	43,587
FAILED STEAMTRAPS	-	-	-	-	-	-	-	-	$0	0
DEFECT. HUMIDIFIER	-	-	-	-	-	-	-	-	$0	0
EMERGENCY GENERATORS	-	-	-	-	-	-	270	$1,661	$1,661	270
TOTALS	7,729	$33,003	33,524	$168,861	15,573	$114,928	270	$1,661	$318,312	57,098

Total MBTU/YR = 57,098 MBTU/YR

ENERGY UTLIIZATION INDEX (EUI) = BTU/Gross SF-YR = 57,098,000,000 BTU/YR / 321,821 SF

= 177,415 BTU/SF-YR

TABLE 1 - T2

RECOMMENDED ECO'S

BUILDING #4500
MONCRIEF ARMY COMMUNITY HOSPITAL

ECO #	DESCRIPTION	ANNUAL SITE MBTU's SAVED			ANNUAL SOURCE MBTU's SAVED			TOTAL ANNUAL SOURCE MBTU's SAVED	INITIAL COST	ANNUAL DOLLAR SAVINGS	SIMPLE PAYBACK (YEARS)	SIR
		ELEC.	CHW	HTW	ELEC.	#6 FUEL	NAT.GAS					
4500 - 1	CURRENT CRITERIA TEMPERATURES - AHU-3S		845	90	40	345	1,470	1,855	$58	$9,176	0.01	2186.4
4500 - 2	CURRENT CRITERIA TEMPERATURES - AHU-3N		545	33	26	216	919	1,161	$58	$5,741	0.01	1367.0
4500 - 3	REPAIR DEFECTIVE HUMIDIFIER		272	1,194	13	426	1,813	2,252	$180	$11,085	0.02	857.8
* 4500 - 4	OPTIMIZED DECK RESET AHU-2		1,812	3,670	86	1,679	7,153	8,918	$712	$43,919	0.02	848.5
4500 - 5	OPTIMIZED DECK RESET AHU-3S		1,137	565	54	584	2,489	3,127	$712	$15,827	0.04	296.1
4500 - 6	OPTIMIZED DECK RESET AHU-4N		824	653	39	489	2,084	2,612	$712	$13,039	0.05	243.8
4500 - 7	OPTIMIZED DECK RESET AHU-3N		833	346	40	410	1,745	2,195	$712	$11,150	0.06	205.5
* 4500 - 8	CURRENT CRITERIA CFM AHU-3S	271	832	445	311	436	1,857	2,604	$1,538	$15,408	0.10	126.2
4500 - 9	CURRENT CRITERIA TEMPERATURES - AHU-2		(389)	684	(19)	37	158	176	$30,586	$675	45.28	23.3
4500 - 10	REPAIR STEAM TRAPS			622		168	715	883	$927	$4,318	0.21	21.2
* 4500 - 11	HEAT RECOVERY UNIT SHUTDOWN	425	41	761	427	221	939	1,587	$5,491	$8,822	0.62	19.5
* 4500 - 12	NIGHT SHUTDOWN / SETBACK AHU-2	1,304	1,491	3,222	1,375	1,436	6,118	8,929	$38,953	$47,518	0.82	15.2
4500 - 13	REDUCE DOMESTIC HOT WATER TEMPERATURE			0.7		0.2	1	1	$7	$5	1.56	13.6
* 4500 - 14	REPAIR EXISTING HVAC CONTROLS	982	1,978	(1,430)	1,076	365	1,554	2,995	$14,313	$17,325	0.83	11.3
4500 - 15	ENERGY SAVING SHOWERHEADS			151		41	173	214	$2,027	$1,045	1.94	10.9
* 4500 - 16	ISOLATE UNOCCUPIED OPERATING SUITES	64	353	185	76	145	620	841	$9,258	$4,305	2.15	6.2
4500 - 17	SOLAR FILM INSTALLATION		479	(32)	23	173	738	934	$25,000	$6,209	4.03	4.8
4500 - 18	INCANDESCENT TO FLUORESCENT	437			437			437	$29,369	$9,398	3.12	3.3
* 4500 - 19	NIGHT SHUTDOWN / SETBACK AHU-1	2,044	295	(51)	2,058	98	418	2,574	$50,596	$17,762	2.85	3.1
4500 - 20	EXIT LIGHT CONVERSION	64			64			64	$5,532	$800	6.91	15.1
* 4500 - 21	WEATHERSTRIP		31	82	1	28	121	150	$5,404	$744	7.3	2.9
4500 - 22	LIGHTING REDUCTION / OPTICAL REFLECTORS	274			274			274	$19,662	$4,188	4.69	2.4
4500 - 23	ENERGY EFFICIENT MOTORS	275			275			275	$25,790	$3,456	7.5	1.4
4500 - 24	PERSONNEL SENSORS	29			29			29	$2,067	$212	9.75	1.1
	TOTALS	6,169	11,379	11,171	6,705	7,297	31,085	45,087	$269,664	$252,125	1.07	

Legend:
ELECT = Electricity
CHW = Chilled Water
HTW = High Temperature Water
#6 FUEL = # 6 Fuel Oil
NAT.GAS = Natural Gas

NOTE - The totals reflected here do not reflect synergy between ECO's.
Synergistic effects are reflected in Table 1 - T2.

* These ECO's may have been considered in previous studies.

TABLE 1 - T3

RECOMMENDED ECO's

BUILDING #4323
OLIVER DENTAL CLINIC

ECO #	DESCRIPTION	ANNUAL SITE MBTU's SAVED			ANNUAL SOURCE MBTU's SAVE			TOTAL ANNUAL SOURCE MBTU'S SAVED	INITIAL COST	ANNUAL DOLLAR SAVINGS	SIMPLE PAYBACK (YEARS)	SIR
		ELECT.	CHW	HTW	ELECT.	#6 FUEL	NAT. GAS					
4323 - 1	RESET SPACE TEMPS. TO CURRENT CRITERIA			472		127	543	670	$28	$3,279	0.01	1639
4323 - 2	REDUCE HOT WATER TEMPERATURE			2		0.5	2	2.5	$7	$14	0.52	41
4323 - 3	OPTIMIZE AIR DISTRIBUTION SYSTEM	87	8	67	87	21	90	198	$1,305	$1,600	0.82	12.9
4323 - 4	INCANDESCENT TO FLUORESCENT CONVERSION	13			13			13	$947	$300	3.15	2.7
4323 - 5	SHUT OFF CIRCULATION PUMPS	2			2			2	$84	$16	5.35	1.61
4323 - 7	NIGHT SETBACK - AHU SHUTDOWN	38	3	166	36	46	195	277	$12,128	$1,445	8.4	1.28
4323 - 8	ENERGY EFFICIENT MOTORS MOTORS	14			14			14	$1,423	$162	8.8	1.17
	TOTALS	152	11	707	152	194.5	830	1176.5	15922	6816	2.34	

TABLE 1 - T4

RECOMMENDED ECO's

BUILDING #4590
CALDWELL DENTAL CLINIC

ECO #	DESCRIPTION	ANNUAL SITE MBTU's SAVED			ANNUAL SOURCE MBTU's SAVED			TOTAL ANNUAL SOURCE MBTU's SAVED	INITIAL COST	ANNUAL DOLLAR SAVINGS	SIMPLE PAYBACK (YEARS)	SIR
		ELECT.	CHW	HTW	ELECT.	#6 FUEL	NAT. GAS					
4590 - 1	OPTIMIZE AIR DISTRIBUTION SYSTEM	198	24	198	247	62	266	575	$2,285	$7,001	0.33	27.8
4590 - 2	REDUCE HOT WATER TEMPERATURE			0.9		0.2	1	1.2	$7	$6	1.14	18.9
4590 - 3	ENERGY EFFICIENT MOTORS	23			23			23	$2,197	$259	8.5	1.22
4590 - 4	LIGHTING REDUCTION - OPTICAL REFLECTORS	33			33			33	$1,637	$626	2.62	4.39
	TOTALS	254	24	199	303	62	267	632	$6,126	$7,892	0.78	

Legend: ELEC. = Electricity
CHW = Chilled Water
HTW = High Temperature Water
#6 FUEL = # 6 Fuel Oil
NAT.GAS = Natural Gas

TABLE 1 - T5

RECOMMENDED ECO's

BUILDING #5330
HAGEN DENTAL CLINIC

ECO #	DESCRIPTION	ANNUAL SITE MBTU's SAVED			ANNUAL SOURCE MBTU's SAVED			TOTAL ANNUAL SOURCE MBTU's SAVED	INITIAL COST	ANNUAL DOLLAR SAVINGS	SIMPLE PAYBACK (YEARS)	SIR
		ELECT.	CHW	HTW	ELECT.	#6 FUEL	NAT. GAS					
5330 - 1	REDUCE HOT WATER TEMPERATURE			2		0.5	2	2.5	$7	$13	0.56	37.9
5330 - 2	OPTIMIZE AIR DISTRIBUTION SYSTEM	96	8	64	96	20	86	202	$1,305	$1,678	0.78	13.4
5330 - 3	INCANDESCENT TO FLOURESCENT CONVERSION	32			32			32	$1,501	$549	2.73	2.89
5330 - 4	NIGHT SETBACK - AHU SHUTDOWN	64	3	165	64	45	194	303	$12,128	$1,648	7.4	1.42
	TOTALS	192	11	231	192	65.5	282	539.5	14941	3884	3.85	

Legend: ELEC. = Electricity
CHW = Chilled Water
HTW = High Temperature Water
#6 FUEL = # 6 Fuel Oil
NAT.GAS = Natural Gas

TABLE 1 - T6

MONCRIEF ARMY HOSPITAL - FORT JACKSON, SOUTH CAROLINA
ENERGY CONSERVATION OPPORTUNITIES

A. Heating, Ventilating, and Air Conditioning:

1. Shut off air handling units whenever possible.
2. Reduce outside air intake when air must be heated or cooled before use.
3. Reduce volume of air circulated through air handling units.
4. Shut off or reduce speed of room fan coils.
5. Shut off or reduce stairwell heating.
6. Shut off unneeded circulating pumps.
7. Reduce humidification to minimum requirements.
8. Reduce condenser water temperature.
9. Cycle fans and pumps.
10. Reduce pumping flow, and check load on pump.
11. Reset thermostats higher during cooling and lower during heating.
12. Repair and maintain steam lines and steam traps.
13. Use damper controls to shut off air to unoccupied areas.
14. Reset hot and cold deck temperatures based on areas with greatest need.
15. Raise chilled water temperature.
16. Shed loads during peak electrical use periods.
17. Use outside air for free cooling whenever possible.
18. Reduce reheating of cooled air.
19. Recover heating or cooling with energy recovery units.
20. Reduce chilled water circulated during light cooling loads.
21. Install minimum sized motor to meet loads.
22. Replace hand valves with automatic controls.
23. Install variable air volume controls.

TABLE 1 - T7

TABLE 1 - T7 (CONT'D.)

24. Common manifolding of chillers.

25. Insulate ducts and piping.

26. Eliminate simultaneous heating and cooling.

27. Install night setback controls.

28. Clean coils.

29. Maintain filters.

30. Repair and/or maintain air handling controls.

31. Variable air volume.

32. Shut off loading dock lights (use a timer) during daylight hours.

B. Boiler Plant (Boiler Plant is not included in this Scope.)

C. Lighting

1. Shut off lights when not needed.

2. Reduce lighting levels.

3. Revise cleaning schedules.

4. Convert to energy efficient systems.

D. Building Envelope

1. Reduce infiltration by caulking and weatherstripping.

2. Install storm windows or double pane windows.

3. Install roof insulation.

4. Install loading dock seals.

5. Install vestibules on entrances.

6. Install solar shading, screening, curtains and blinds.

7. Install insulation in walls.

E. Electrical Equipment

1. Shut off elevators whenever possible.

2. Shut off pneumatic tube system whenever possible.

3. Install capacitors or synchronous motors to increase power factor.

4. Use emergency generator to reduce peak demand.

5. Shed or cycle electrical loads to reduce peak demand.

6. Balance loads.

7. Reduce transformer losses by proper loading and balancing.

8. Convert to energy efficient motors.

9. Check motor H.P. and replace with smaller motor if appropriate.

10. Modify elevator controls to permit programming.

F. Plumbing

1. Reduce domestic hot water temperature.

2. Repair and maintain hot water and steam piping insulation.

3. Install flow restrictors.

4. Install faucets which automatically shut off water flow.

5. Decentralize hot water heating.

6. Add piping insulation.

7. Electrically trace hot water supply piping to eliminate return piping and pumps.

G. Laundry - Laundry is not included in this scope.

H. Other ECOs

1. Investigate feasibility of cogeneration at the hospital.

2. Modify existing kitchen exhaust heat recovery units to enable shut-down when kitchen is not in operation.

3. Install personnel sensors where applicable to turn lights off where they are typically, inadvertently, left on during unoccupied periods.

MODIFICATION

EEAP Study - Moncrief Army Community Hospital
Fort Jackson, South Carolina

1. The Scope of Work for this EEAP study shall be modified as stated herein.

2. The purpose of this modification is to expand and modify the work as needed in order to require a study of the interaction of the Hospital's air conditioning and HTW systems with the Central Energy Plant. In particular, with regards to the following:
   A. The impact of chilled water distribution temperature changes on the Hospital's air conditioning system and space conditions.
   B. The impact of Central Energy Plant High Temperature Water (HTW) distribution temperature changes on Hospital systems and conditions.

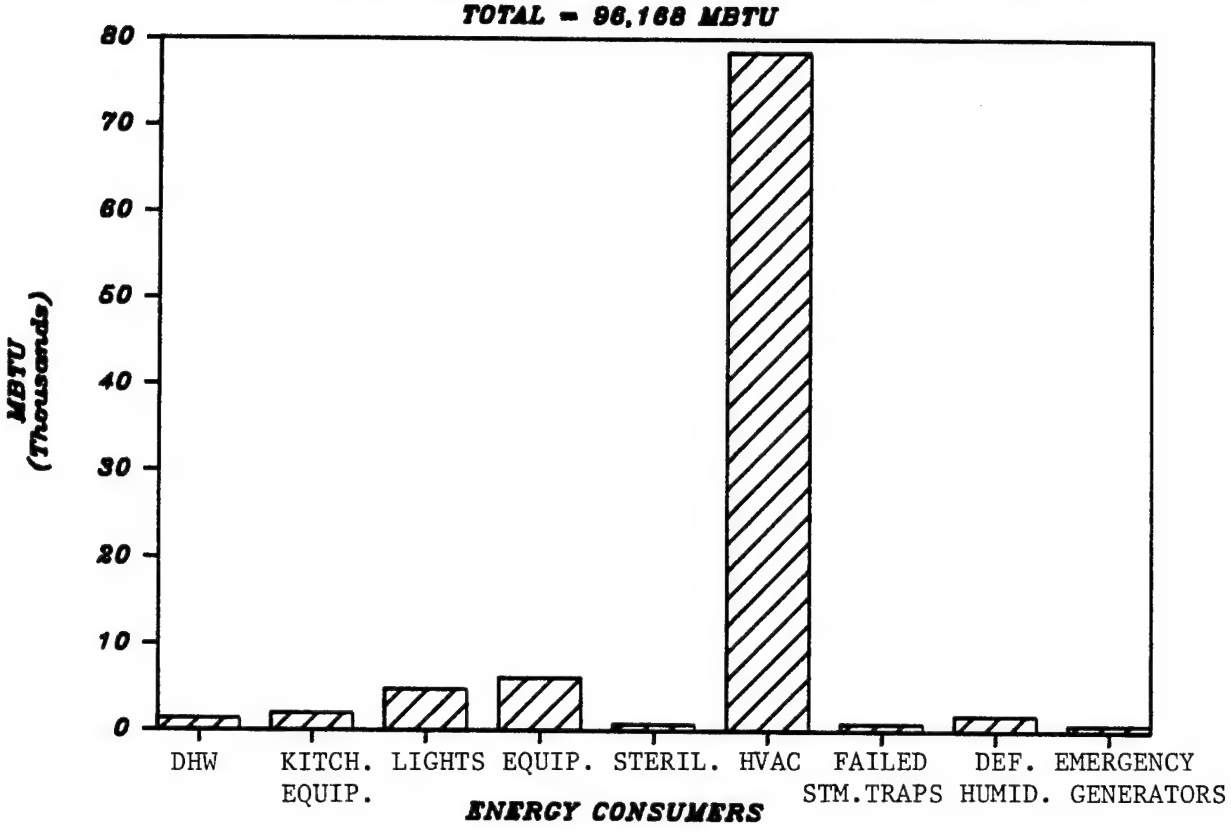
3. The objectives of the study shall be as follows:
   A. To determine all areas of the Hospital in which space condition criteria (particularly humidity and temperature) could not be met if Central Plant chilled water temperature was raised to 52°F.
   B. To determine and evaluate all feasible alternatives (e.g., new central plant at the Hospital), which could be used for bringing the spaces found in 3.A. above back into compliance with criteria if the Central Energy Plant chilled water temperature was set at 52°F.
   C. To determine all impacts on the Hospital and its systems which would result from reductions in Central Energy Plant HTW distribution temperatures to as low as 250°F.
   D. To determine and evaluate all feasible alternatives (e.g., local steam generation) which could be used for resolving the impacts found in 3.C.
   E. To evaluate and report on any other anticipated impacts to the Hospital due to such changes in Central Plant distribution temperatures.

4. Fort Jackson will provide any available data, upon request, which may be needed to evaluate and compute energy costs and savings at the Central Plant as a result of the reduction in chilled water temperatures. If needed data is not available and cannot be obtained, then the AE shall use good Engineering judgement to estimate the missing data. All such estimates must be documented in the report and agreed to by the Government as to reasonableness and accuracy.

5. Any feasible alternatives determined in item 3 above shall be considered as ECO's and shall be reported, evaluated and documented in accord with the General Scope of Work. Energy savings at the Central Plant may be used to justify such ECO's.

6. Analyses made for this study shall use computer modeling methods such as BLAST or other such methods as may be approved by Savannah District.

1986 ANNUAL ENERGY CONSUMPTION



1986 ANNUAL ENERGY COSTS

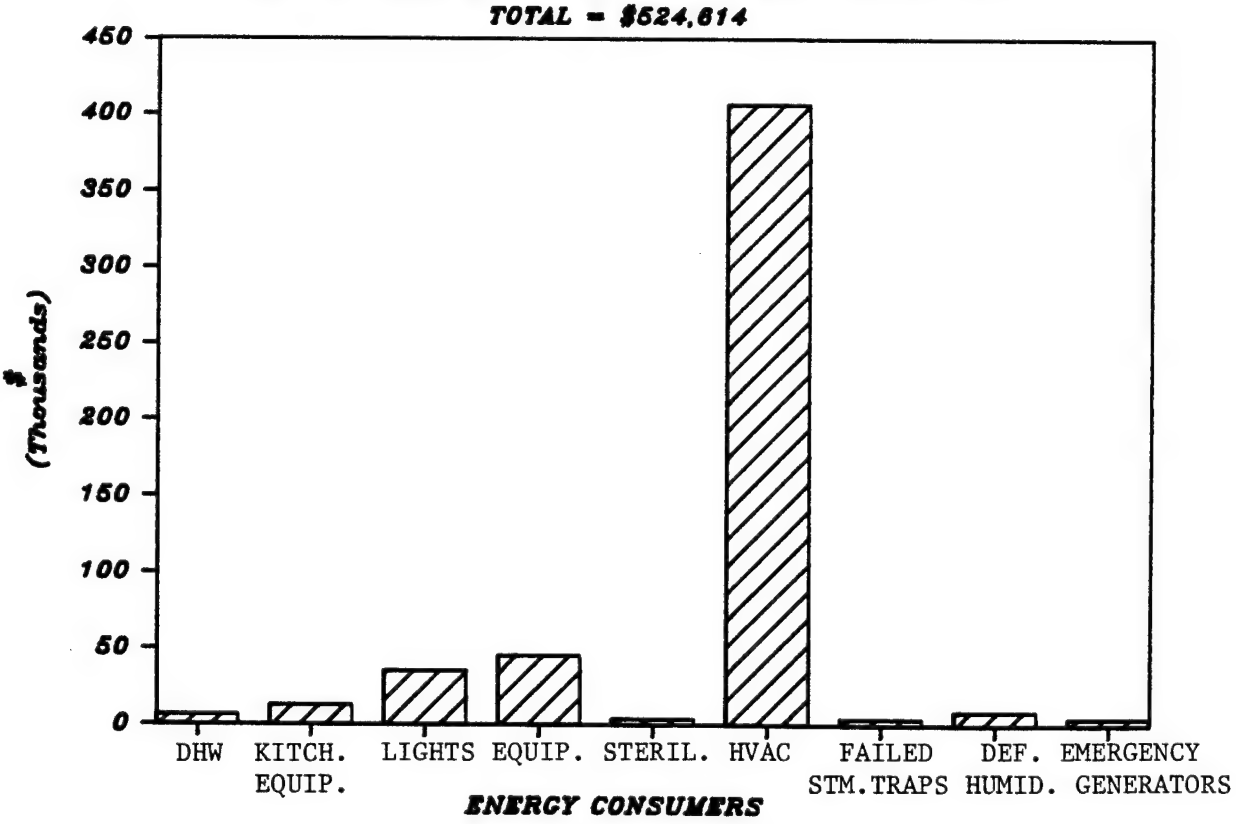


FIGURE 1 - F1

1986 VS PROPOSED ENERGY USAGE

– ANNUAL –

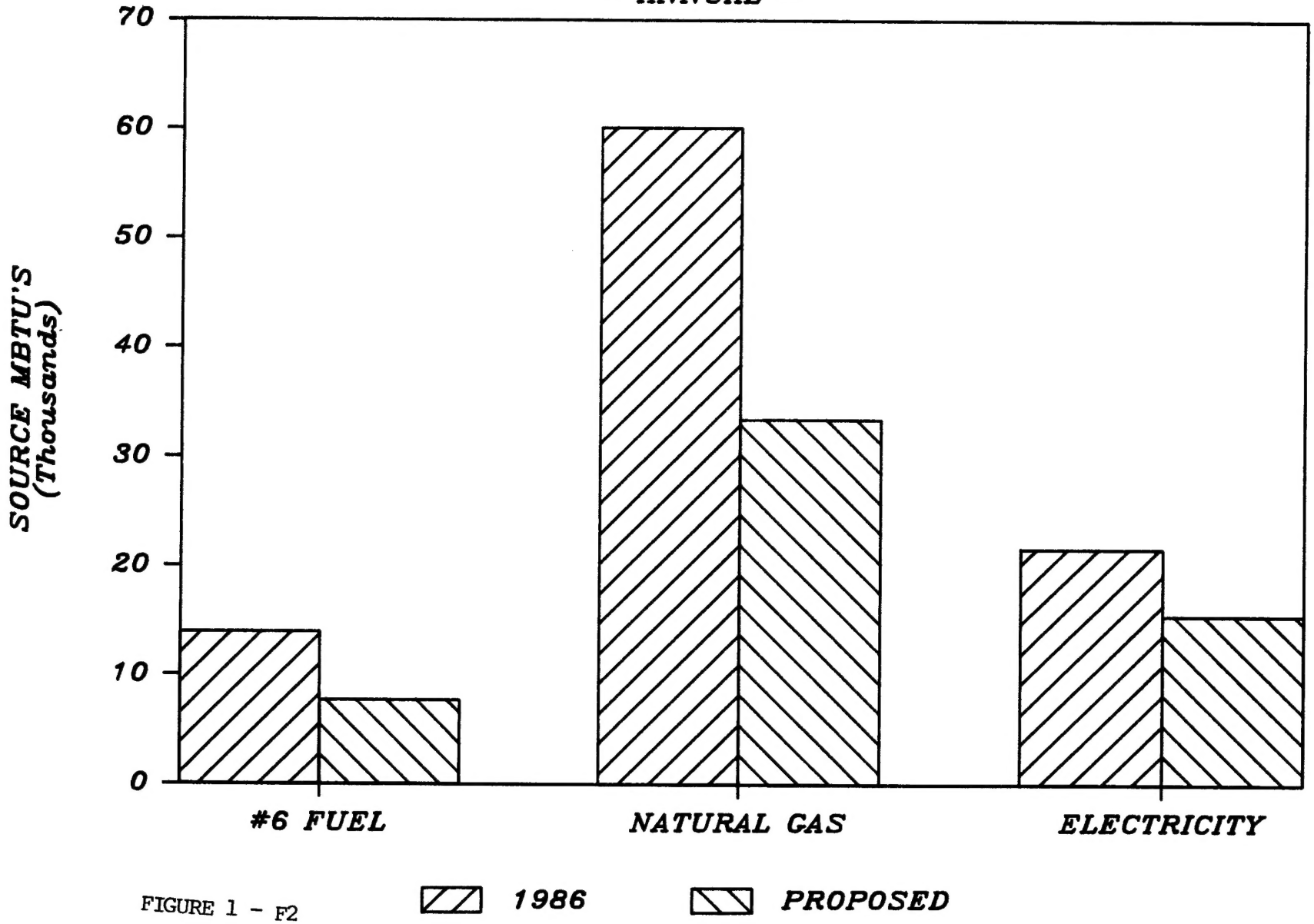


FIGURE 1 - F2

BUILDING 4500, MONCRIEF ARMY COMMUNITY HOSPITAL

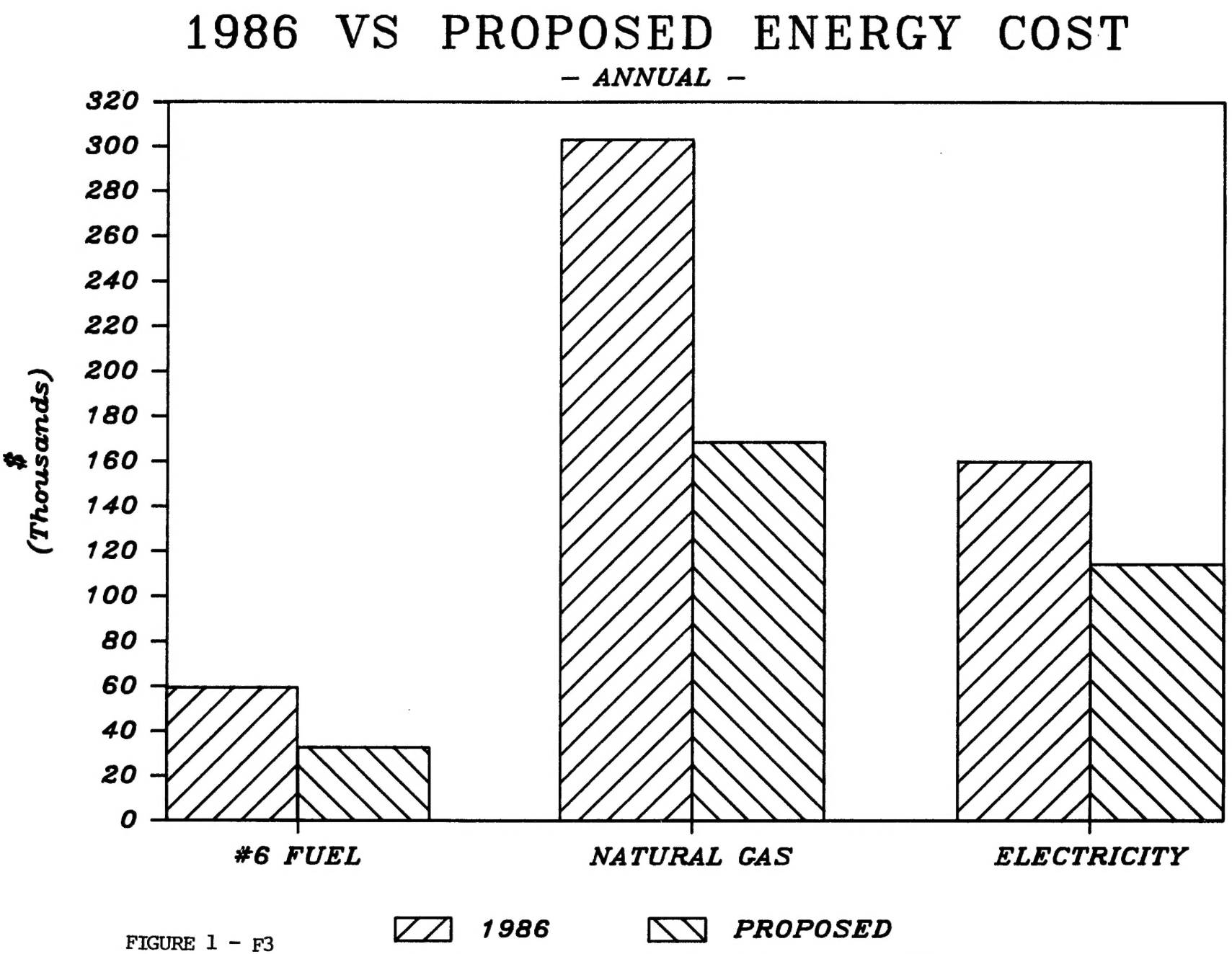


FIGURE 1 - F3

BUILDING 4500, MONCRIEF ARMY COMMUNITY HOSPITAL

DENTAL CLINICS ENERGY SAVINGS

FORT JACKSON, COLUMBIA, S.C.

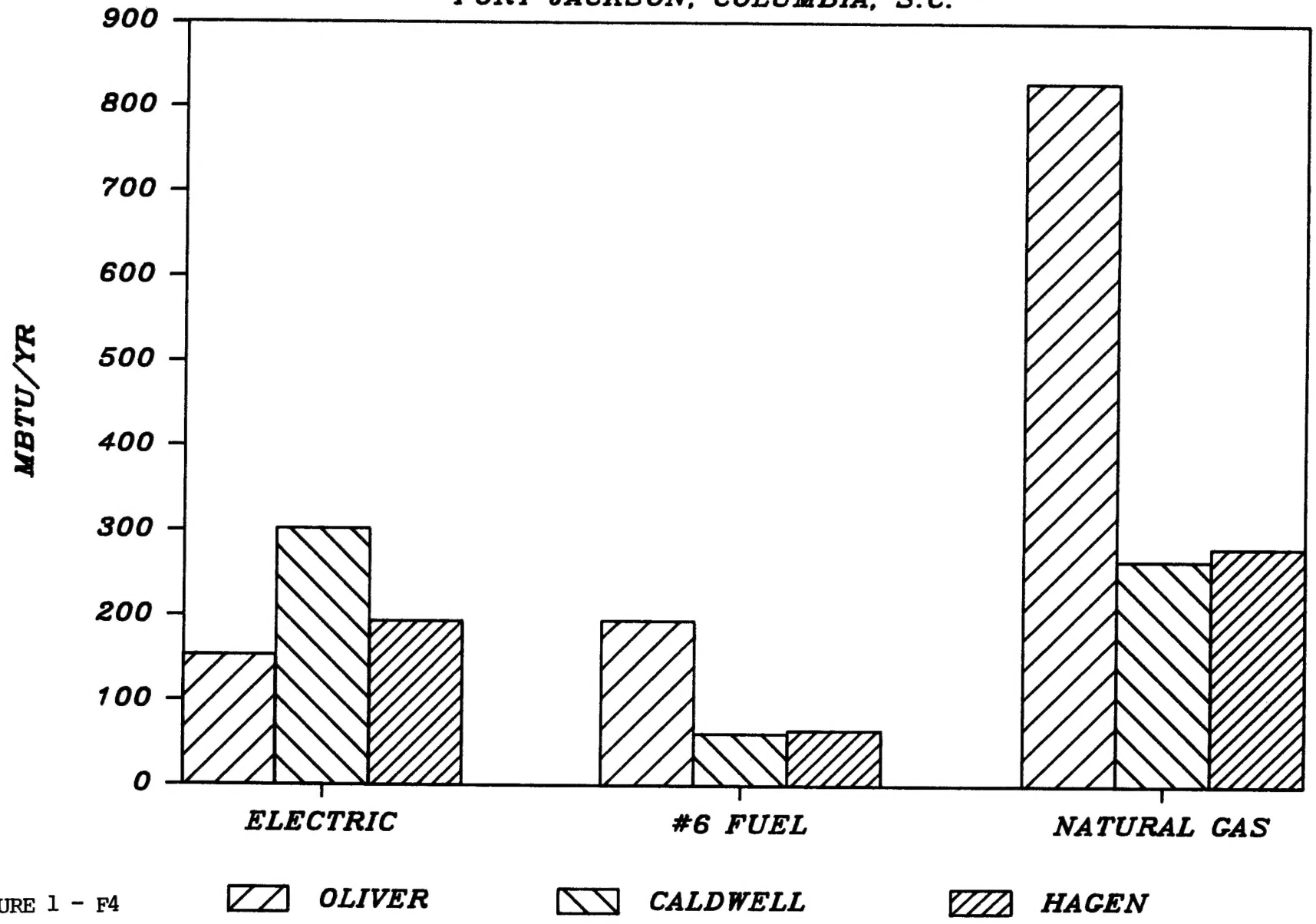


FIGURE 1 - F4

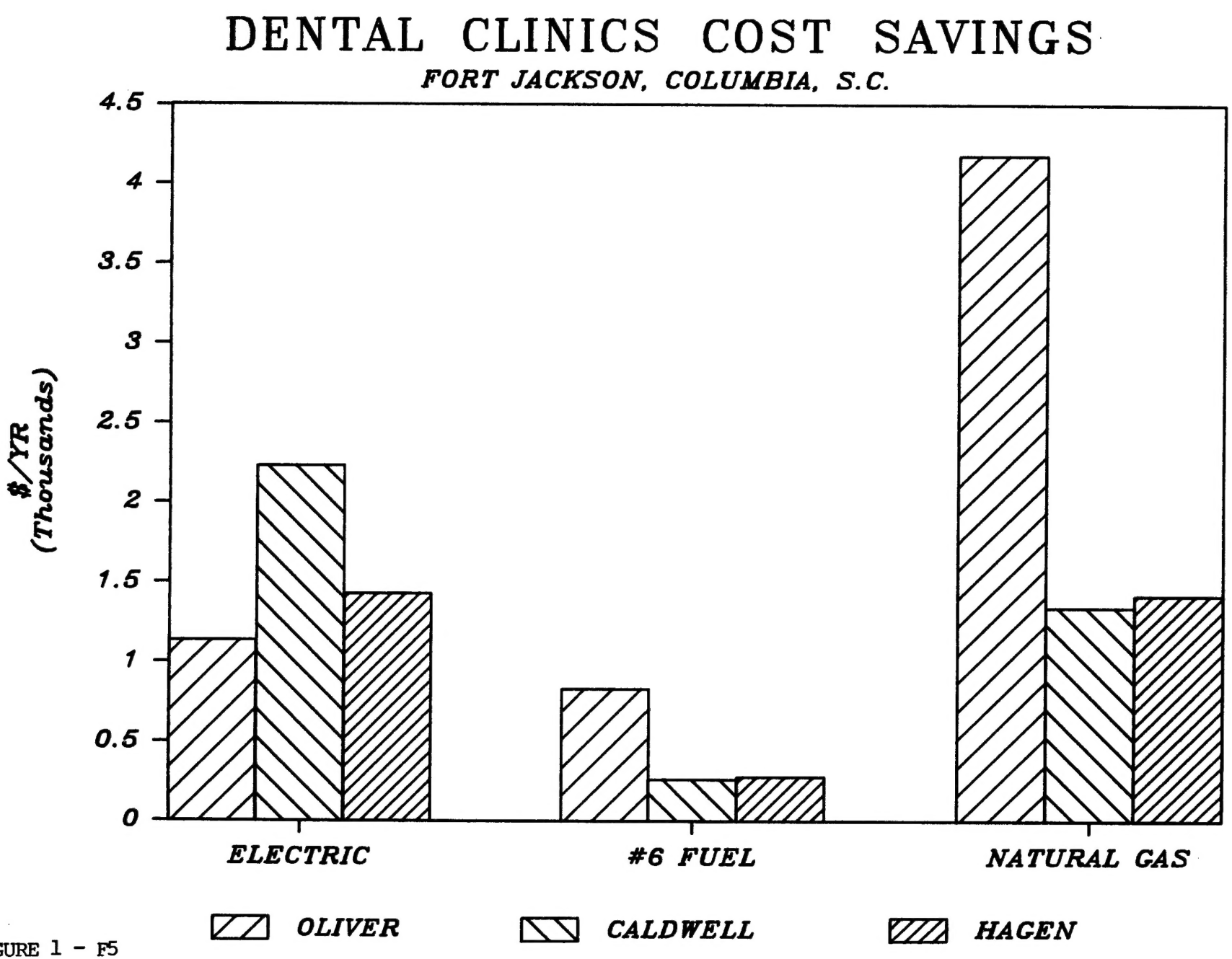

DENTAL CLINICS COST SAVINGS
FORT JACKSON, COLUMBIA, S.C.
$/YR (Thousands)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
ELECTRIC
#6 FUEL
NATURAL GAS
OLIVER
CALDWELL
HAGEN

FIGURE 1 - F5